(19) Japanese Patent Office (JP)

(12) Publication of Laid-Open Patent Application (A)

(11) Publication Number: 6-347774

(43) Publication Date: December 22, 1994

| (51) Int. Cl.$^5$ | | Identification Symbol | | FI |
|---|---|---|---|---|
| G02F | 1/1333 | 500 | 9225-2K | |
| | 1/1343 | | 8707-2K | |

Request for Examination: Not made

Number of Claims: 1 FD (4 pages in total)

(21) Patent Application No.: H5-163876

(22) Filing Date: June 10, 1993

(71) Applicant: 000221627

Tonen Chemical Corp.

4-1-1, Tsukiji, Chuo-ku, Tokyo

(72) Inventor: Takeshi Hosoyama

c/o Research & Development Center, Tonen Chemical Corp.

3-1 Chidori-cho, Kawasaki-ku, Kawasaki-shi, Kanagawa

(72) Inventor: Yoshihiro Arai

c/o Research & Development Center, Tonen Chemical Corp.

3-1, Chidori-cho, Kawasaki-ku, Kawasaki-shi, Kanagawa

(74) Agent: Patent Attorney, Mitsuo Matsui

(54) [Title of the Invention] ELECTRODE FILM FOR LIQUID CRYSTAL DISPLAY PANEL

(57) [Abstract]

[Object] To provide an electrode film for a liquid crystal display panel, which is superior in terms of chemical resistance.

[Constitution] An electrode film for a liquid crystal display panel, which has a structure of a protective layer / a base film (except for a cellulose acetate resin) / a protective layer / a transparent conductive layer. At least one layer of the protective layers is an organic resin layer including a resin layer having a urethane bond. The other protective layer may be another organic resin layer or an inorganic protective layer as well.

[Scope of Claims]

[Claim 1]

An electrode film for a liquid crystal display panel, in which at least a transparent conductive layer is provided over an optically isotropic transparent base film, characterized in that the base film is an organic resin film except a cellulose acetate resin and protective layers are provided over both surfaces of the base film, where at least one of the protective layers is an organic resin layer including a resin layer having an urethane bond, and wherein a transparent conductive layer is provided over one surface of any one of the protective layers.

[Detailed Description of the Invention]

[0001]

[Industrial Field of the Invention]

The present invention relates to an electrode film for a liquid crystal display panel, and in more detail, relates to an electrode film for a liquid crystal display panel using an organic film as a base film.

[0002]

[Related Art and the Object]

As an electrode used in a liquid crystal display panel, one in which a layer of a compound $In_2O_3$-$SnO_2$ (hereinafter, referred to as ITO) is provided over a glass substrate is

well known. However, in such an electrode using the glass substrate, the problem of having low impact resistance when being carried or increasing the weight in accordance with the increase of the display panel in size is caused, and the improvement has been sought. In such a situation, an electrode film, in which an organic film substrate (base film) was used instead of using the glass substrate and an ITO film was formed thereover, was proposed.

[0003]

However, although such a base film is required to have properties such as transparency, no polarization property like glass, and chemical resistance accompanied by patterning of ITO, a base film which adequately satisfies these requisite properties is not known yet.

[0004]

Therefore, it is an object of the present invention to provide an electrode film for a liquid crystal display panel, which is superior in terms of protective property, especially, chemical resistance.

[0005]

[Means to Solve the Problem]

The present invention provides an electrode film for a liquid crystal display panel, in which at least a transparent conductive layer is provided over an optically isotropic transparent base film, characterized in that the base film is an organic resin film except a cellulose acetate resin and protective layers are provided over both surfaces of the base film, where at least one of the protective layers is an organic resin layer including a resin layer having an urethane bond, and a transparent conductive layer is provided over one surface of any one of the protective layers.

[0006]

As the optically isotropic transparent base film used in the present invention, the organic resin film except the cellulose acetate resin can be used, and for example, films of polycarbonate, polyarylate, amorphous polyolefin, polyethersulfone, polysulfone, and the like can be given. Each of these films can be used as a single or by laminating two or

more kinds. A thickness of the film is preferably 55 ~ 5000 μm.

[0007]

In the present invention, the protective layers are provided over the both surfaces of the base film, and at least one side of the protective layers is an organic resin layer including a resin layer having an urethane bond. By applying such a protective layer, an effect of high chemical resistance could be obtained. Here, the resin having the urethane bond refers to a resin which can be obtained by a reaction of one or more kinds of compounds having isocyanate groups and a polyol compound. As the compound having the isocyanate group, for example, a diisocyanate compound such as toluene diisocyanate, diphenylmethane diisocyanate, or dimethyldiphenyl diisocyanate; modified isocyanate compounds which are formed by chemically modifying those compounds; and the like can be given. As the polyol compound, the compound may be, for example, a low molecular weight polyol such as ethylene glycol, propylene glycol, glycerin, pentaerythritol, or sorbitol; a high molecular weight polyol which uses those polyols as starting materials, for example, polyether-based polyol, polyester-based polyol, or polyetherester-based polyol; and a modified compound thereof, for example, acryl acid modified polyol, epoxy modified polyol, or the like, and there is particularly no limitation.

[0008]

The organic resin layer may use another resin by being mixed with the resin having an urethane bond, or may have a multilayer structure. As such another resin, for example, an epoxy-based resin, an acrylic-based resin, a polyester-based resin, a polyamide-based resin, a phenolic-based resin, a silicone-based resin, an ethylene-vinyl alcohol-based copolymer, an acrylonitrile-butadiene-based resin (for example, an ABS-based resin), a polyvinyl chloride-vinyl acetate-based copolymer, and the like can be given, and each of these resins can be used as a single or by mixing two or more kinds.

[0009]

When the protective layer is not the organic resin layer including a resin layer having an urethane bond, the protective layer may be another organic resin layer or an inorganic protective layer as well. In the case of the other organic resin layer, one or

more kinds of the above-mentioned resins can be used.

[0010]

In the case where the protective layer is an organic resin layer, a thickness of the protective layer is preferably in the range of 1 ~ 20 μm. The organic resin layer can be provided by a common means, for example, such as coating by gravure coating or the like. In the case of the organic resin layer including a resin layer having an urethane bond, for example, a material, that is a mixture of a compound having an isocyanate group and polyol, can be applied by gravure coating or the like.

[0011]

In the case of using an inorganic protective layer as the protective layer, the inorganic material used in such an inorganic protective layer is preferably at least one kind of compound selected from a silicon compound, a titanium compound, and an aluminum compound. As the silicon compound, for example, silicon oxide represented by $SiO_x$ (preferably, x = 1.3 ~ 2.0), silicon nitride represented by $SiN_x$ (preferably, x = 1.1 ~ 1.5), silicon nitride oxide (for example, $SiN_xO_y$ (preferably, x = 1.0 ~ 1.4, y = 1.1 ~ 1.9)), silicon carbide (SiC), and the like can be given. As the titanium compound, for example, $TiO_2$, TiC, and the like can be given. As the aluminum compound, for example, $AlO_x$ (preferably, x = 1.1 ~ 1.8), $AlN_x$ (preferably, x = 0.8 ~ 1.6), and the like can be given. The inorganic protective layer can be provided by a known film forming method such as an evaporation method, a sputtering method, an ion plating method, a CVD method, a spray method, or the like. A thickness of the inorganic protective layer is preferable in the range of 200 ~ 4000 angstrom. The inorganic protective layer is not necessarily a single layer, and it may be a laminate of two or more layers.

[0012]

The transparent conductive layer is provided over (one surface of) the above-mentioned protective layer. As the transparent conductive layer, a common material of a transparent conductive layer, for example, metal oxide can be used. Specifically, for example, $SnO_2$, CdO, ZnO, a CTO group ($CdSnO_3$, $Cd_2SnO_4$, or $CdSnO_4$), $In_2O_3$, $CdIn_2O_4$, and the like can be given. The transparent conductive layer is preferably

a dual (doping) phase in which one or more kinds selected from Sn, Sb, F, and Al are added into the above-mentioned metal oxide. Among them, $In_2O_3$ into which Sn is added (ITO), $SnO_2$ into which Sb is added, $SnO_2$ into which F is added, or the like is preferable. A single layer or a multilayer of these layers can be used as the transparent conductive layer. A thickness of the layer is different depending on the material; however, for example, an ITO layer is preferably 200 ~ 3500 angstrom, especially preferably 300 ~ 3100 angstrom. The sheet resistance of the transparent conductive layer is not particularly limited as long as it is 400 Ω/□ or less. The transparent conductive layer can be provided by a known film forming method such as an evaporation method, a sputtering method, an ion plating method, a CVD method, a spray method, or the like.

[0013]

The electrode film of the present invention has a structure of the protective layer / base film / protective layer / transparent conductive layer. The protective layer is not necessarily a single layer, and another protective layer can further be provided as a base layer of one protective layer. In addition, the organic resin layer and the inorganic protective layer can be used in combination. In other words, the electrode film of the present invention can employ, for example, the following structure: an organic resin layer / a base film / an inorganic protective layer / a transparent conductive layer; an organic resin layer / an inorganic protective layer / a base film / an inorganic protective layer / a transparent conductive layer; an inorganic protective layer / an organic resin layer / a base film / an inorganic protective layer / a transparent conductive layer; an inorganic protective layer / a base film / an organic resin layer / a transparent conductive layer; an inorganic protective layer / a base film / an inorganic protective layer / an organic resin layer / a transparent conductive layer; an inorganic protective layer / a base film / an organic resin layer / an inorganic protective layer / a transparent conductive layer; an organic resin layer / an inorganic protective layer / a base film / an organic resin layer / a transparent conductive layer; an organic resin layer / a base film / an inorganic protective layer / an organic resin layer / a transparent conductive layer; an organic resin layer / a base film / an organic resin layer / an inorganic protective layer / a transparent conductive layer; an

inorganic protective layer / an organic resin layer / a base film / an organic resin layer / a transparent conductive layer; an inorganic protective layer / an organic resin layer / a base film / an organic resin layer / an inorganic protective layer / a transparent conductive layer; or an organic resin layer / an inorganic protective layer / a base film / an inorganic protective layer / an organic resin layer / a transparent conductive layer.

[0014]

In the above embodiment mode, at least one organic resin layer is necessarily a layer containing a resin having an urethane bond. When there are two or more layers of each organic resin layer or inorganic protective layer, they may be in the same kind or different kinds.

[0015]

The thus obtained electrode film for a liquid crystal display panel of the present invention preferably has transmittance of 80 % or more as a whole with respect to visible light, and the deterioration of the transmittance due to the film formation is, in comparison with the base film, preferably 8 % or less.

[0016]

[Embodiment]

According to the embodiment below, the present invention will be further explained in detail.

Embodiment 1

Over both surfaces of a polyarylate film of 100 μm thickness, a coating liquid, in which 6 w/t parts of an ethyl acetate solution which contains 75 volume % toluene diisocyanate (TDI) and 100 w/t parts of an acryl acid modified polyol solution containing pyroxylin (containing 31 volume % acryl acid modified polyol, article name: UM-AL medium, manufactured by Dainichiseika Color & Chemicals Mfg. Co., Ltd.) were mixed, was applied by gravure coating so as to have a thickness of 5 μm. Next, over one surface of this, an ITO layer having a thickness of 1000 angstrom was formed by a sputtering method. In other words, a powder sintered compact of $In_2O_3$ and $SnO_2$ (weight ratio 90 :

10) was used as a target, and a mixed gas of argon and oxygen ($Ar/O_2$ = 90/10; volume ratio) was used as a reaction gas.

[0017]

Thus, an electrode film having a structure of an organic resin layer / a base film / an organic resin layer / the ITO layer could be obtained. The following described chemical resistance test was performed. The test results are shown in Table 1.

(1) Acid resistance test: after soaked in a 10 % HCl solution at 50 °C for 30 minutes, hot-air drying was performed.

(2) Solvent resistance test: after soaked in acetone for 30 minutes, hot-air drying was performed.

(3) Alkaline resistance test: after soaked in a 20 % NaOH solution at 50 °C for 30 minutes, hot-air drying was performed.

Embodiment 2

Over one surface of a polyarylate film of 100 μm thickness, a coating liquid, in which 100 w/t parts of a mixed liquid of 25 volume % epoxy modified polyol (article name: EP-6027, manufactured by Asahi Denka Co., Ltd), 50 volume % ethyl acetate, 15 volume % toluene, and 10 volume % methyl ethyl ketone was added and mixed into 15 w/t parts of an ethyl acetate solution which contains 75 volume % TDI used in Embodiment 1, was coated by gravure coating so as to have a thickness of 4 μm. Next, over a surface of the base film, which is opposite to this organic resin layer, a $SiO_2$ layer was formed so as to have a thickness of 1200 angstrom by an ion plating method. Continuously, an ITO layer having a thickness of 1000 angstrom was formed over this $SiO_2$ layer by a sputtering method. The sputtering condition was the same as that of Embodiment 1.

[0018]

The chemical resistance test for the obtained electrode film (the organic resin layer / the base film / the $SiO_2$ layer / the ITO layer) was performed under the same condition as that of Embodiment 1. The result is shown in Table 1.

Comparative Example

An ITO layer having a thickness of 1000 angstrom was directly formed on one surface of a polyarylate film having a thickness of 100 μm by a sputtering method in the same manner as Embodiment 1, without providing an organic resin resin layer.

[0019]

The chemical resistance test for the obtained electrode film (a base film/ the ITO layer) was performed in the same condition as that of Embodiment 1. The result is shown in Table 1.

[0020]

[Table 1]

TABLE 1

| Chemical Resistance Test | Embodiment 1 | Embodiment 2 | Comparative Example |
|---|---|---|---|
| Acid Resistance Test | No change | No change | No change |
| Solvent Resistance Test | No change | No change | Turbid |

Note that when the above electrode film was incorporated into a liquid crystal display panel, there was no problem in operation as the electrode film.

[0021]

[Effect of the Invention]

An electrode film for a liquid crystal display panel of the present invention is superior in terms of chemical resistance and a long lifetime of the panel, and has industrially high usability.